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Using PETTLEP imagery as a simulation technique in nursing: research and guidelines

**Abstract**

One of the most valuable skill sets developed in nurse education is the ability to develop the clinical and practical skills learned. This can take various forms such as university-based practice, simulation and direct experience with patients. To this end imagery, a process where all of the senses are used to create or recreate an experience in the mind, could represent simulated practice of clinical skills. Research on imagery has indicated that the technique can be used to assist in the performance of skill based procedures carried out by nurses can be beneficial. However, guidelines are lacking in this area of simulated practice. In this article, we review current research on the topic of imagery in enhancing skilled performance and outline a model that can assist in conducting interventions. Furthermore, we consider how this could be implemented within a nursing environment to produce beneficial performance effects in both pre-registration and registered nurses.

Keywords: simulation, PETTLEP, nursing, training, simulation

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## Introduction

Practical, clinical skills lie at the heart of nurses' professional practice. Therefore, the mastery of fundamental clinical skills is an important component in academic programmes leading to registration. In the clinical field 'doing' is important (Major, 2005). Training in a nursing environment requires mastering of technical skills, followed by the development of expertise (Benner, Sutphen, Leonard, & Day, 2010). One such way in which expertise is fostered is through the use of simulation. Simulated practice is commonplace in nurse education and has been used for a number of years in addition to clinical practice skill development (Moule, 2011). Simulation can act as a "near experience" (McNeish, 2015, p.1) and this exposure to real life scenarios develops confidence and competence, and can support evidence based learning in a safe environment.

Simulation is the reproduction of the essential features of a real life situation (Medley & Horne, 2005). Therefore, it enables experiential learning in a safe environment, and research has demonstrated a significant improvement in undergraduate nurses' performance and knowledge of OSCE clinical skills through the use of patient simulated technology (Alinier, Hunt, Gordon & Harwood, 2005). It also gives students the opportunity to be involved in approximations of real-world settings, whilst being confronted with the challenging task of establishing a relationship whilst eliciting clinical information (Wallace, Rao, & Haslam, 2002). Regulatory guidelines vary across the international context but indicate that several of the required training hours can be spent in simulated environments.

Clinical simulation can be used as an effective tool in skill learning if it is an accurate reproduction of a clinical environment (McGaghie, Issenberg, Petrusa and Scalese, 2010). This has been made easier as technological advancement allows simulation to become increasingly close to real world practice conditions (Meakim et al., 2013). Although nurse educators strive to mimic reality in their practice laboratories, they find that nursing students often do not make the imaginative leap required to visualise a dummy model as a real patient (Alinier et al., 2005). Consequently, students often experience difficulty making the transition from learning laboratory to the real patient setting. To better facilitate this transition, nursing institutions have begun moving from static, plastic models to costly, interactive computerised models, with high-fidelity simulation becoming increasingly used in nurse training. This can be defined as "experiences using full scale computerized patient simulators, virtual reality or standardized patients that are extremely realistic and provide a high level of interactivity and realism for the learner" (Meakim et al., 2013, p. S6). Recent studies have supported the effectiveness of such experiences, with a recent review of 45 such studies concluding that high-fidelity simulation enhances psychomotor skill acquisition and decision making skills (D'Souza, Arjunan & Venkatesaperumal, 2017).

An additional method of simulation that has proved popular and effective in many contexts is that of mental simulation, often termed 'imagery'. Imagery is defined as the process by which we can represent perceptual information in our minds in the absence of sensory input (Kosslyn et al., 2006). However, despite the obvious potential of imagery for use as a clinical simulation strategy in nursing, little has been published on this topic. In particular, an imagery model aimed at promoting high-fidelity imagery in sports, termed PETTLEP (Holmes & Collins, 2001), appears suitable for use in nurse settings. The aim of this paper is to examine the possible uses of PETTLEP in nurse education. First, we explain the PETTLEP model and its underlying research, then we examine the research that has tested the model to date. We then explore the current extent literature on the uses of PETTLEP-style imagery in medical settings, and conclude by providing suggestions regarding how PETTLEP imagery can be implemented in nurse education settings.

Though this is intended as a position paper rather than a review of the imagery literature per se, we note our literature search strategy here for completeness: we searched Google Scholar, Medline, CINAHL and PsycINFO using the following search terms: PETTLEP, mental imagery, clinical simulation, intermediate-fidelity simulation and high-fidelity simulation. The reference lists of articles were then searched for further relevant sources. However, before briefly reviewing the literature examining the effectiveness of PETTLEP imagery, the following sections will explain the concept of imagery, then that of PETTLEP imagery specifically.

## Imagery

Imagery is arguably the most commonly used, and most-researched, psychological skill in sport (e.g., Morris, 2010) and is used with the aim of performance improvement amongst athletes. Several reviews and meta-analyses have examined the impact of imagery on the performance of motor skills (e.g., Feltz & Landers, 1983; Weinberg, 2008). However, in addition to examining the efficacy of imagery as a performance enhancer, in recent years there has been a burgeoning of interest in the neural basis of mental imagery.

Convergence of research on imagery across a number of disciplines owes to the 'functional equivalence' hypothesis (Jeannerod, 1994) which postulates that action execution and simulated action share similar neural processes. Numerous studies have investigated this sharedness using measures such as fMRI (Taube et al., 2015) and functional near-infrared spectroscropy (Abdalmalek et al., 2016). As a result, growing evidence exists that both imagery and observation of motor movements consist of similar neural processes as those experienced during preparation and execution of movement owing to the same internal representation (see Hardwick et al., 2018, for a quantitative review of meta-analyses). Therefore, a strong link between imaged action and executed action has evolved suggesting that motor imagery, if used appropriately, can enhance the activation of internal processes linked to psychomotor skill performance.

## PETTLEP imagery

Despite the increased understanding of the mechanisms through which imagery enhances motor performance that has been achieved through the neuroscience research cited in the previous section, Holmes and Collins (2001) argued that much of the application of imagery in sports settings had tended to lack theoretical understanding and rigour. This disparity between research and practice prompted Holmes and Collins to develop the PETTLEP model of motor imagery. PETTLEP is an acronym, with each letter standing for an important practical consideration to be made when devising and implementing an imagery intervention. These are Physical, Environment, Task, Timing, Learning, Emotion and Perspective (see Table 1 for a breakdown of the components and a guide of how to implement these.

These are important practical components to consider when implementing meaningful and realistic motor-based imagery modalities. The inclusion of elements of the physical task, in an internally driven access procedure, is assumed to subsequently access greater proportions of motor representation (Holmes & Collins, 2001). Careful consideration of the meaningful aspects of the task is therefore essential when applying and integrating the seven components into motor imagery. The purpose of this is to best facilitate the probability of accessing more shared brain regions to strengthen the cortical pathways used during action (Beisteiner et al., 1995). Such strengthening of cortical pathways from imagery has been demonstrated recently in stroke patients, for example (Li et al., 2018).

**Research on PETTLEP imagery**

Prior to the development of the model, several imagery studies examined elements that were later included within it (for example Smith and Holmes 2004; Smith et al., 2001). However, since its conception, several studies have examined the PETTLEP model in a variety of different tasks and situations (Ramsey et al., 2010; Wakefield & Smith, 2009). Whilst these have included strength based tasks (Wright & Smith, 2009, Wakefield & Smith, 2011), a wide range of studies have been conducted examining PETTLEP imagery on skilled movement (Smith et al., 2008; Wright & Smith, 2007). Indeed, two studies by Smith et al. (2007) focussed on PETTLEP imagery in using different sports skills, the hockey penalty flick and the gymnastics full turning jump, with results strongly supportive of PETTLEP. In study one, forty-eight varsity hockey players were randomly assigned to one of four groups: sports-specific imagery, clothing imagery, traditional imagery (involving relaxing and visualising) and control. Post-test results revealed that the sport-specific imagery group scored significantly higher than the clothing imagery group, who scored significantly higher than the traditional imagery group. In study two, forty female gymnasts were randomly assigned to one of four groups: PETTLEP, physical practice, stimulus and control. The PETTLEP group received response training based upon the seven components of the model. However, the stimulus group received response training that incorporated only some components of the PETTLEP model (*T*iming and *P*erspective components). Results revealed that performance of both the physical practice and PETTLEP groups improved significantly from pre-test to post-test, with no significant difference between them. However, the stimulus and control groups did not improve significantly. Therefore, taken together, the results from this study provide support for the efficacy of PETTLEP-based imagery over more traditional imagery interventions.

A study examining EEG data in rifle shooters (Holmes et al., 2006) revealed that whilst the condition deemed to be most congruent with performance demonstrated the most similar neural profile to action execution, all action observation conditions showed some congruence with the physical condition. Therefore, it appears that merely adding further components of the PETTLEP model may not enhance the matching from an EEG perspective. Wakefield et al. (2012) suggested that shared actions and behaviours may not automatically result in a shared neural substrate. Thus, it is “through behavioural and environmental modification that we can hope to exert some control over the ‘shareness’ of neural correlates” (Wakefield et al., 2012, p.11) and therefore that behavioural matching might be a more appropriate term.

To summarise, from the research covered it has become evident that the PETTLEP model has begun to undergo testing within the field of sport psychology, with very positive results. However, Holmes and Collins (2001) explain that the model would benefit from comprehensive testing in a variety of settings.

## Imagery in the medical profession

Imagery is a technique that has also been employed widely in recent years in the medical profession, particularly in surgical procedures. For example, Saunders et al. (2008) conducted a study examining the use of imagery on surgical skills. Results revealed the group that received imagery training outperformed the textbook study group on a live rabbit surgery task. A further study by Arora et al. (2011) demonstrated that conducting mental practice prior to virtual reality laparoscopic procedures had a significant impact on the quality of performance of novice surgeons. A review paper conducted by Cocks et al. (2014) found that, whilst imagery had been shown to be beneficial in novice surgeons, the effects had not yet been explored in experts, despite promising results with established performers in sport.

Such research findings and applications have only sparingly been applied to a nursing setting. Research has shown that guided imagery can assist with transition from nurse education into a professional role (Boehm & Tse, 2013). These authors recommended that guided imagery, a process by which imagination is directed towards a relaxed positive state (Achterberg, 1985) can result in increased concentration and stress reduction, thus preparing nurses for a real life environment. Few studies have examined the use of imagery in a nursing situation. Studies which have employed such techniques, have typically focussed on guided imagery with the aim of stress reduction and anxiety control (Speck, 1990; Suk et al., 2002; Stephens, 1992; Contrades, 1991). For example, Suk et al. employed a guided imagery intervention with 18 nursing students and found a significant reduction in anxiety levels and improvement in performance level compared to a control group. Such findings are also apparent in music settings and Clark and Williamon (2011) found that after an imagery programme, participants reported increased self awareness, confidence and heightened control over anxiety: outcomes that would also be useful in a nursing setting.

Imagery has been advocated, for example, as an aid to examination performance (Fleet, Goodchild & Zajchowsky, 1999). PETTLEP, aimed as it is at the imagery of motor tasks, therefore may be particularly helpful when the examination in question is one that involves psychomotor skills. One such examination that is taken by many thousands of UK health students every year is the Objective Structured Clinical Examination (OSCE). OSCEs, first described by Harden et al. (1975), are well-established assessment methods in medical education and training, nursing and the professions allied to medicine (Harden et al., 2015; Prakash, 1999; Van der Vleuten, 2000). The completion of OSCEs during pre registration nursing training involves the completion of several skilled procedures.

To date, only one study has examined structured imagery in nursing performance, as measured by performance on the OSCEs (Wright et al., 2008). This study employed 56 pre-registration students who either undertook the basic training or a PETTLEP imagery intervention in preparation for their OSCEs. The examinations utilised were blood pressure measurement and aseptic technique. The blood pressure measurement task used in the study involved following a set of procedural guidelines in order to calculate a patient's blood pressure measurement in the appropriate manner. The aseptic technique task involved the preparing and administering of a dressing without causing contamination. An external examiner assessed both of these tasks and the nurses were awarded points for the correct completion of each of the elements of the skill. The PETTLEP-imagery group were interviewed after a practice session of the OSCEs. This was to gain information about their individual experience of the skill. This information was then used to produce individualised imagery scripts for the PETTLEP group. These were used as a source of response training (Lang, Kozak, Miller, Levin & McLean, 1980), as advocated by the PETTLEP model. This involved focusing the participant on their own responses by reinforcing verbal reports of physiological and behavioural involvement in the scene, for example, hearing the systolic and diastolic changes. The intervention for this group was based upon the seven components of the PETTLEP model. Participants were instructed, wherever possible, to perform their imagery dressed in their uniform and holding the pump (for blood pressure measurement). This made the environment as realistic as possible, as the feel of the pump, and the stance required performing the task were included in the imagery. The nurses imaged completing the task three times per week for four weeks prior to the OSCE examinations. The control group continued with their preparation in the usual manner, but none of them recorded the use of conscious or intentional imagery. Diaries were also given to participants to record the number of interventions they completed. The OSCE scores were taken as a measure of effectiveness.

Results indicated that students in the imagery group performed significantly better on blood pressure measurement than those who undertook the basic training. Results for aseptic technique showed no significant difference in performance between the two groups. The authors concluded that imagery may have influence the blood pressure measurement owing the skill psychomotor component, as opposed to aseptic technique which relied heavily on recollection of procedure and therefore may not follow the same neural firing pattern each time it is completed. The authors concluded that further and extensive research is needed to explore this notion further in a range of skill based nursing practices.

**PETTLEP imagery and simulation**

Many of the recommendations of the PETTLEP model would assist in fulfilling the current guidelines on simulation and assist with an effective transition into becoming a registered nurse. However, it should be noted that as good as any simulation experience may be, it cannot entirely replace some of the traditional learning methods, as students still need to learn at the bedside with real patients (Hegarty & Bloch, 2002; Lane, Slavin & Ziv, 2001). It is important that nurses can transfer the learning from simulation into a real life practice setting before qualifying. However, a study by Duchscher (2009) found that when nurses complete the required training they did not feel that they had the academic support that they were used to. Several other studies have been conducted on the culture and content of the simulation training. For example, Harder, Ross and Paul (2013) completed an ethnography on the culture of nursing simulation and observed that students preferred to adopt the active roles within a simulation setting (i.e., that of a lead nurse rather than an observer). Further, McNeish (2015) found that students valued the opportunity to make decisions and take responsibility for the consequences of those decisions. Both adopting a lead role and making key decisions may be problematic situations to practice, especially for inexperienced or pre-registration nurses. Therefore, a structured imagery intervention could be utilised as a tool whereby a variety of differing scenarios and outcomes could be explored in a safe environment. This may allow these roles to be adopted during simulated practice in order for experience and confidence to be gained.

Such a strategy may also prove beneficial given the economics of simulation, where training providers may have difficulty funding 'hands-on' simulated practice. Achterberg, Dossey and Kolkmeier (1994) recommend using all of the senses, rather than just visualisation, to allow the needs of all participants to be accounted for. This closely mirrors the recommendations of the PETTLEP model, which advocates the use of all of the senses in order to gain the most authentic and productive imagery experience.

**Implementation of PETTLEP imagery**

In addition to the seven elements of the PETTLEP model, further consideration is needed regarding the length and duration of the interventions. Studies typically employ a paradigm of a relatively short term intervention of around four to six weeks (e.g., Smith, Wright & Cantwell, 2008; Wakefield & Smith, 2009). However, other studies have demonstrated PETTLEP imagery can significantly improve performance over a much shorter intervention period (45 minutes – Wright & Smith, 2007) and over a longer time (22 weeks – Wakefield & Smith, 2011). Furthermore, consideration must be given to the frequency of the imagery conducted. Whilst many studies use a frequency of twice per week (Smith et al., 2008), studies examining this topic specifically have demonstrated that three times per week was more beneficial (Wakefield & Smith, 2009; Wakefield & Smith, 2011) and positive benefits have been shown for a frequency of four times per week (Ramsey et al., 2010), suggesting that increased frequency will continue to enhance the benefits of imagery. Indeed, a recent meta-analysis (Paravlic, Slimani, Tod, Marusic, Milanovic & Pisot, 2018) found that a frequency of three times per week was associated with enhanced performance.

Research has suggested that imagery is more effective in the early stages of learning (Wrisberg & Ragsdale, 1979) and many of the studies utilising PETTLEP imagery have done so with novice performers (Wright & Smith, 2007; Wakefield & Smith, 2009), exhibiting strong performance results. Indeed, a study by Arora et al. (2011) demonstrated the benefits of imagery with novice surgeons. Therefore, it seems appropriate that imagery be used as a simulation technique during pre-registration training. It is important to note, however, that having developed the skill, practitioners may use it throughout their career in instances of new technique development or refamiliarisation with established techniques.

A further issue to consider is the integration of imagery with other simulation techniques, namely observation or physical practice. Imagery combined with observation could also be a useful simulation technique. Research on skilled performance in a sporting setting has shown that performance improvements can be seem using a combination of imagery and observation, regardless of whether they are done simultaneously or in an alternate manner (Romano-Smith, Wood, Wright & Wakefield, 2018). Other research investigating the effects of observed and imaged exercise (Calabrese et al., 2004; Decety et al., 1991; Wang & Morgan, 1992) have reported increases in ventilation, oxygen consumption and/or heart rate. An explanation for such changes concerns autonomic function usually associated with muscular activity being activated independently from the increases in metabolic demands, indicating activity associated with motor preparation may have an autonomic component in addition to the limb specific muscles being targeted. Studies have also been conducted comparing imagery interventions to physical practice (Smith et al., 2007; Wright & Smith, 2009) with positive results. However, despite studies showing that PETTLEP can be as effective as physical practice in enhancing performance, such comparable results may be due to a motivational effect and are unlikely to be sustained on a longer term basis. This is comparable with physical execution of simulation. McNeish (2015) reported instances where students had gone into a mode of skilled performance during the simulation and are able to imagine performing the skills in a clinical environment. This transfer to a 'real world' environment is an important skill to develop. It may be beneficial therefore for trainees to engage in an intervention that combines the physical simulation and imagery simultaneously or, in the case of a lack of availability of equipment to promote practice time, a programme where both simulation types are conducted but independently of each other.

## Conclusion

Whilst the majority of studies on imagery have been in cognitive psychology, neuroscience and sport settings, improvements have also been seen in other areas of skilled performance such as music (Bernardi, Schories et al., 2013). Such studies provide an interesting insight into how mental skills training and specifically imagery can be beneficial in enhancing skilled performance. The PETTLEP model of imagery provides a framework to enhance the efficacy of imagery interventions and we propose that this should be examined and tested in a variety of arenas including the nursing profession, as an aid to simulation. We hope that this will encourage universities and nurse educators to consider this in order to improve the performance of clinical skills both as a pre-registration tool but also as part of continuing professional development.

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